FIG.1

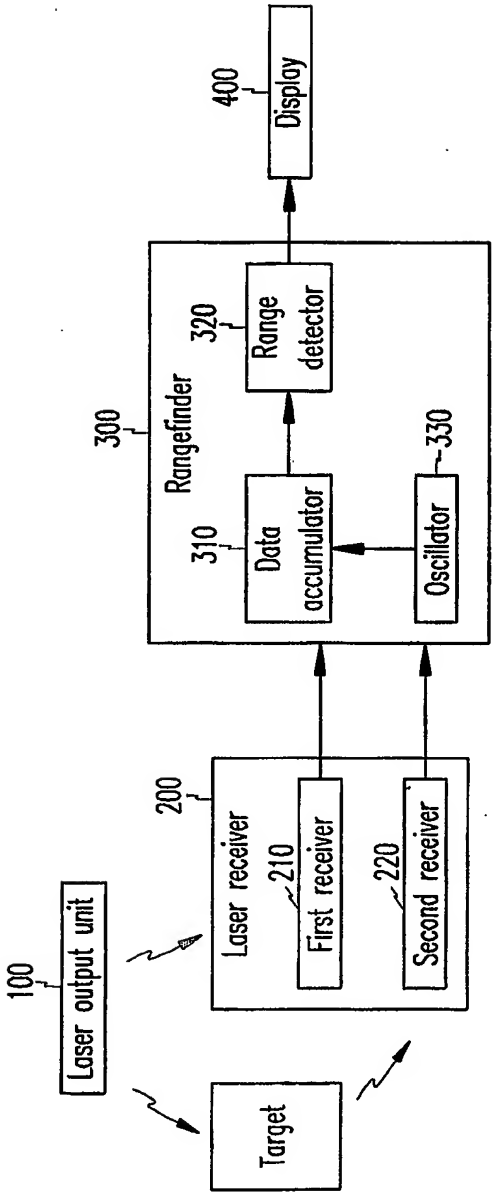

400
Display
300
Rangefinder
320
Range detector
310
Data accumulator
330
Oscillator
200
Laser receiver
210
First receiver
220
Second receiver
100
Laser output unit
Target

FIG.2

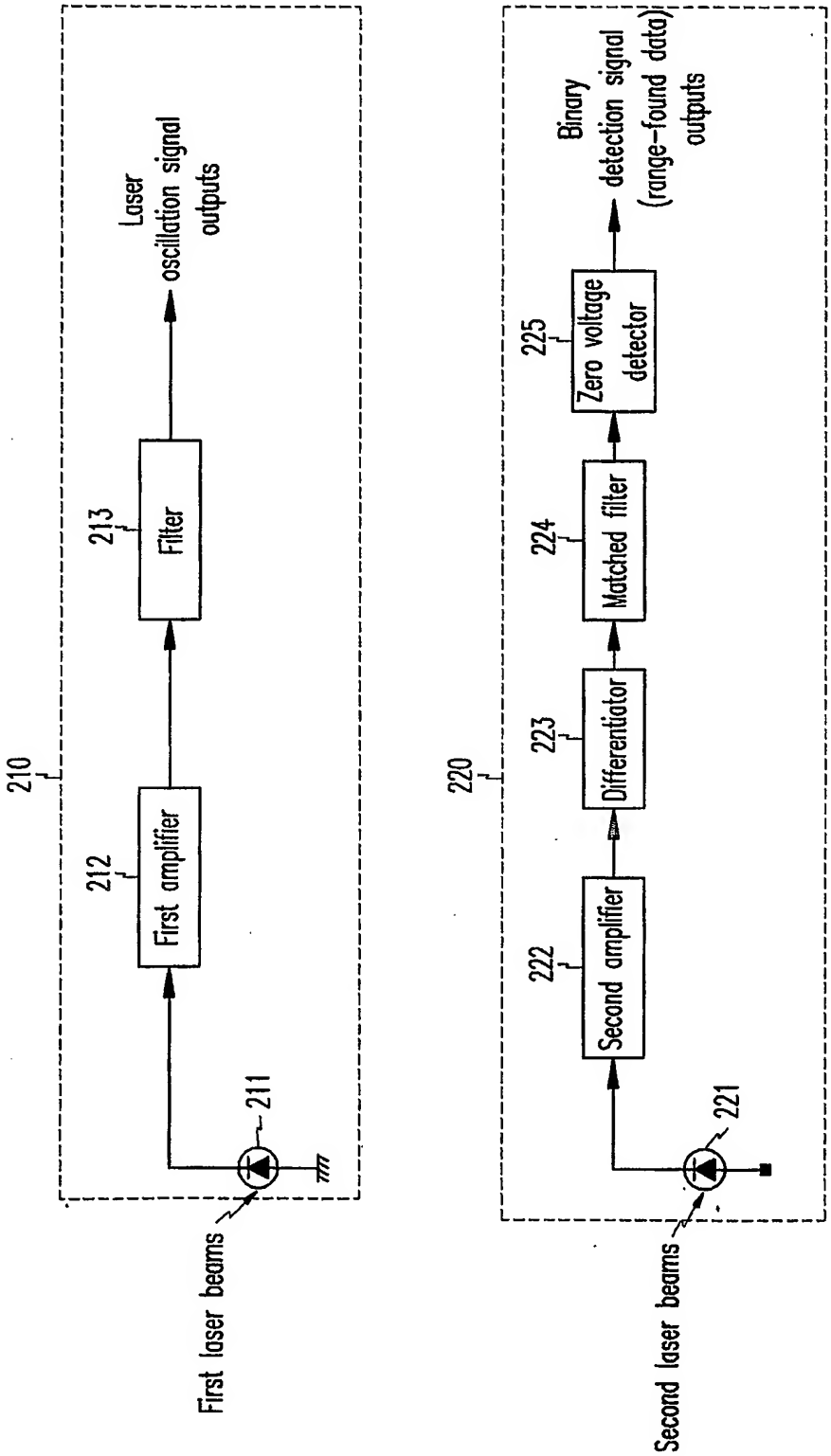

210
212
First amplifier
213
Filter
Laser oscillation signal outputs
211
First laser beams
220
222
Second amplifier
223
Differentiator
224
Matched filter
225
Zero voltage detector
Binary detection signal (range-found data) outputs
221
Second laser beams

FIG.3

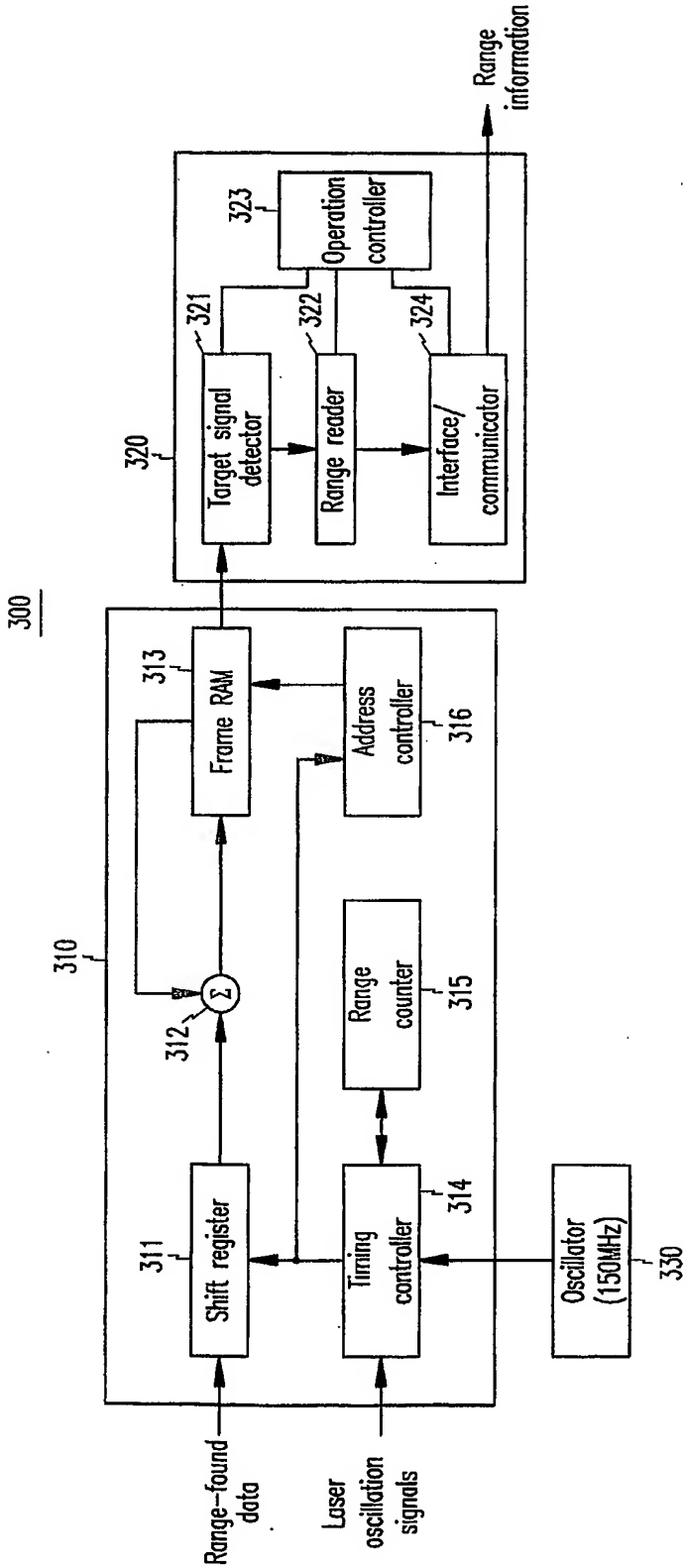
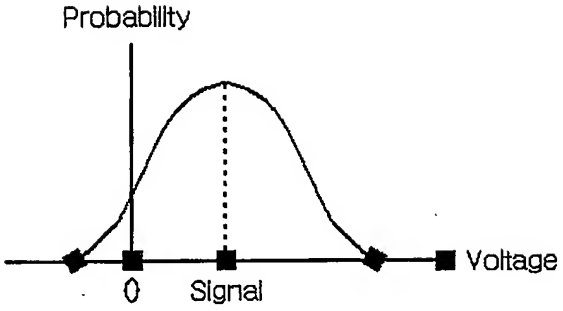
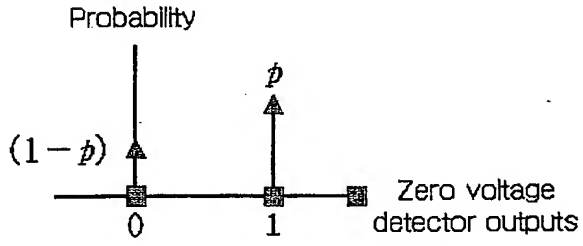

Range information
323
Operation controller
321
322
324
320
Target signal detector
Range reader
Interface/ communicator
300
313
Frame RAM
Address controller
316
310
312
Range counter
315
311
Shift register
Timing controller
314
Oscillator (150MHz)
330
Range-found data
Laser oscillation signals

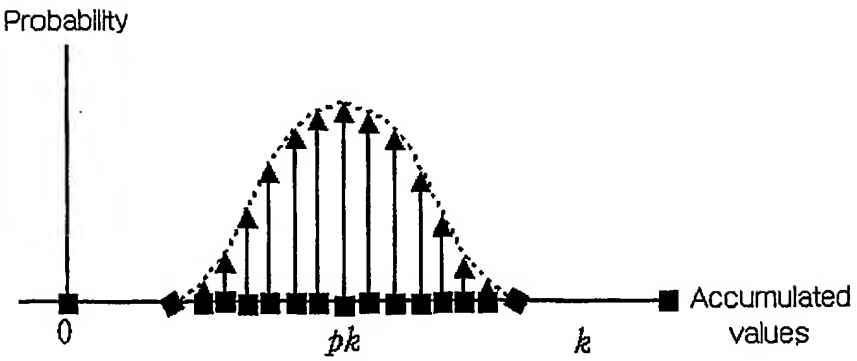
FIG.4



(a) Signals superimposed normal distribution noise



(b) Binary detection probability distribution



(c) Cumulative probability distribution

FIG.5

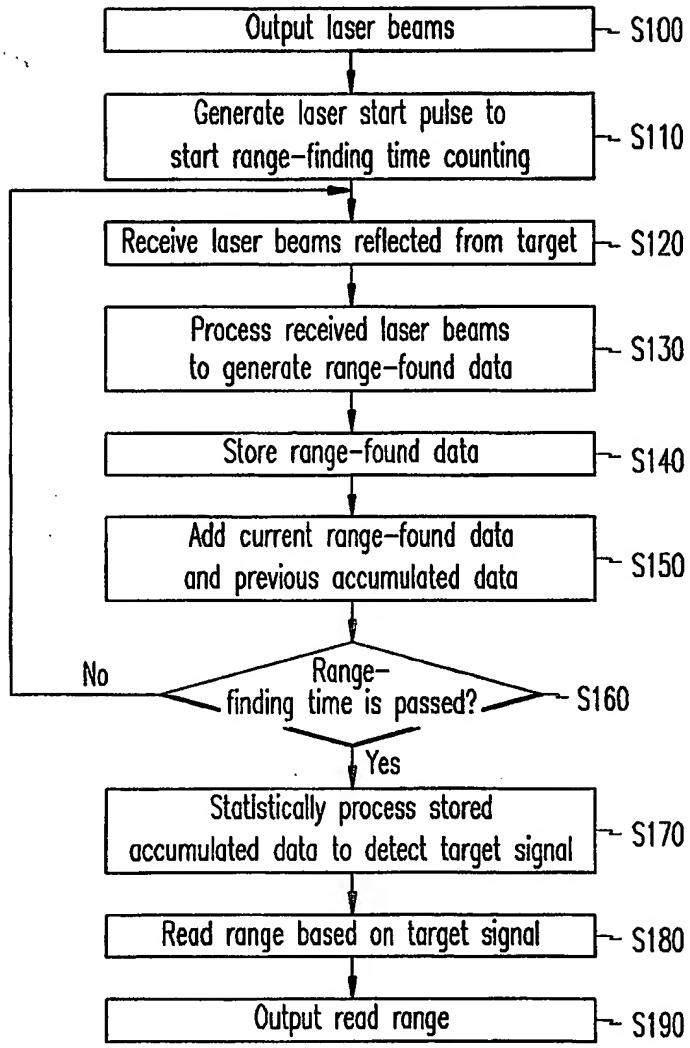

Output laser beams
S100
Generate laser start pulse to start range-finding time counting
S110
Receive laser beams reflected from target
S120
Process received laser beams to generate range-found data
S130
Store range-found data
S140
Add current range-found data and previous accumulated data
S150
Range-finding time is passed?
S160
No
Yes
Statistically process stored accumulated data to detect target signal
S170
Read range based on target signal
S180
Output read range
S190

FIG.6

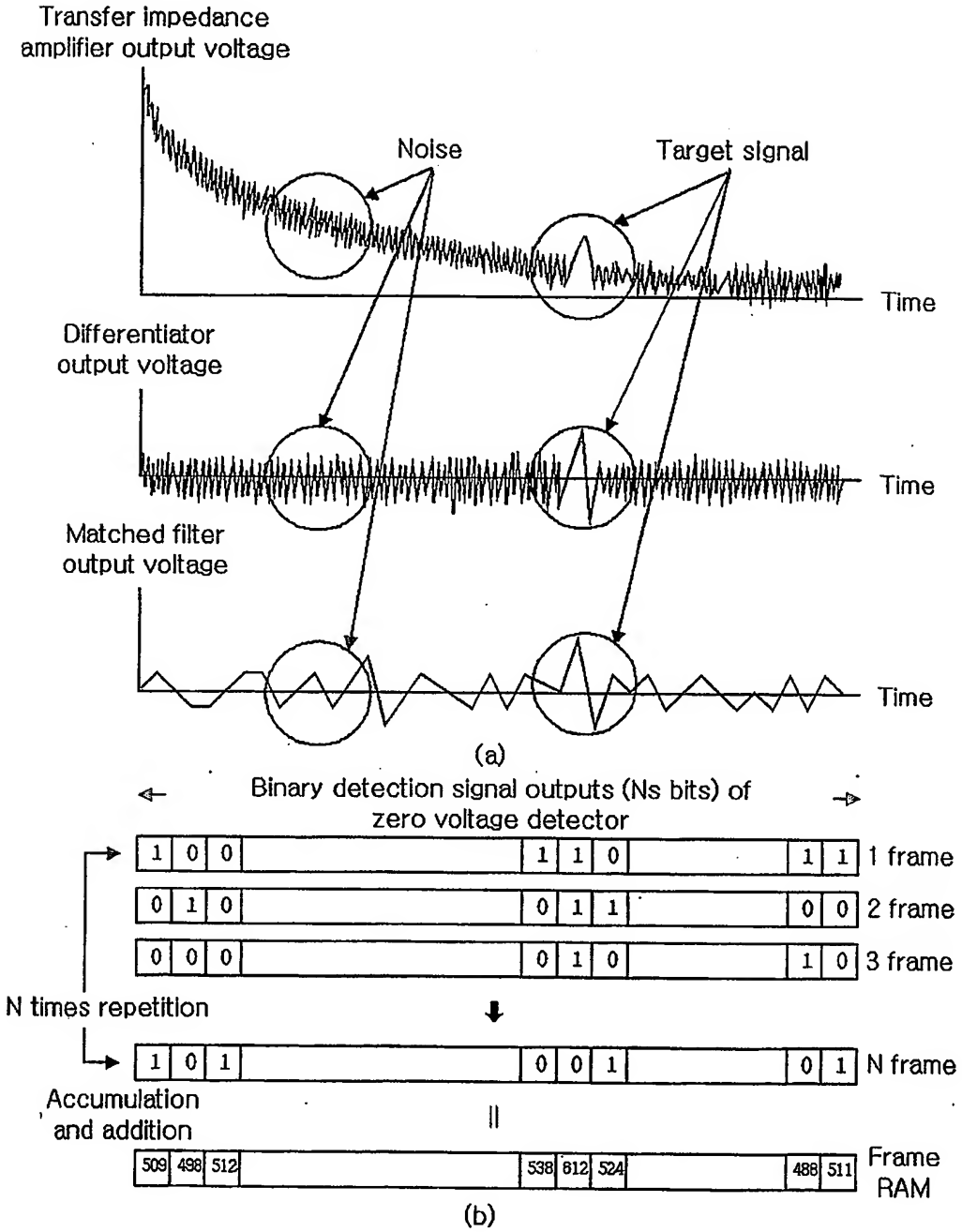

Transfer impedance amplifier output voltage
Noise
Target signal
Time
Differentiator output voltage
Time
Matched filter output voltage
Time
(a)
Binary detection signal outputs (Ns bits) of zero voltage detector
1 0 0 1 1 0 1 1 1 frame
0 1 0 0 1 1 0 0 2 frame
0 0 0 0 1 0 1 0 3 frame
N times repetition
1 0 1 0 0 1 0 1 N frame
Accumulation and addition
509 498 512 538 612 524 488 511 Frame RAM
(b)

FIG.7

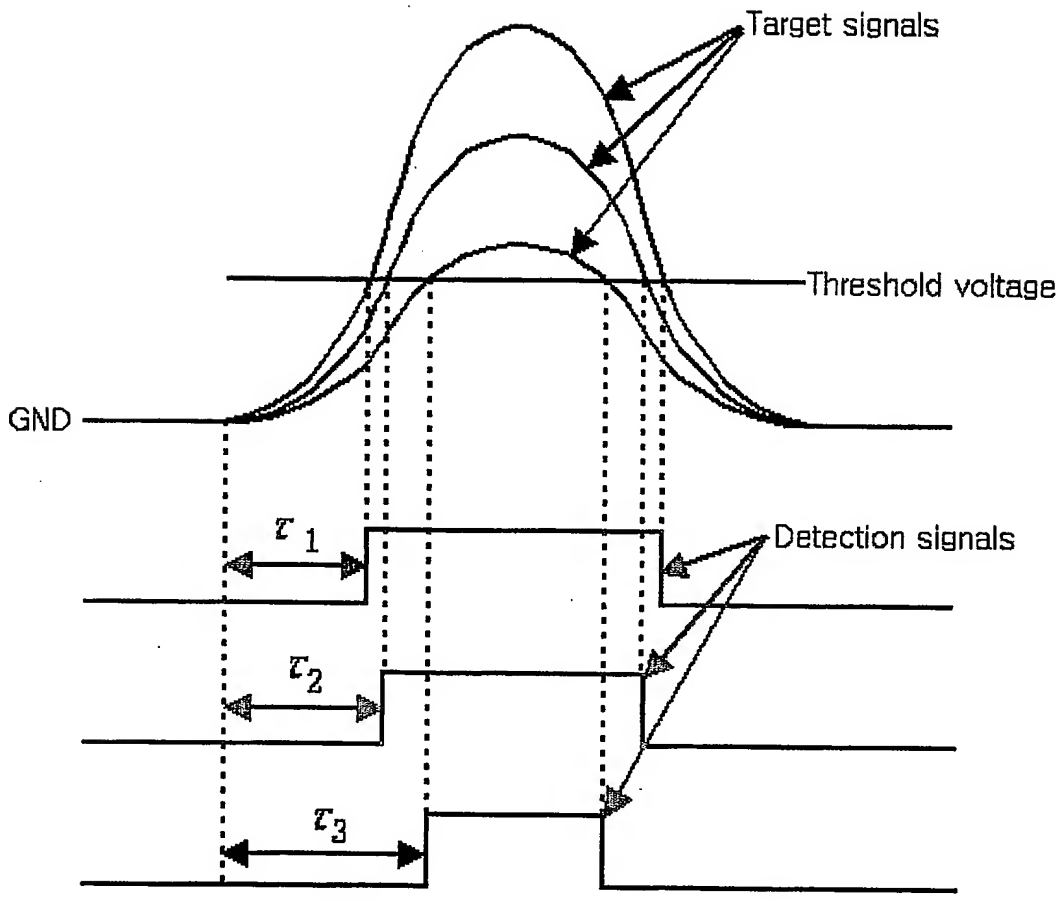
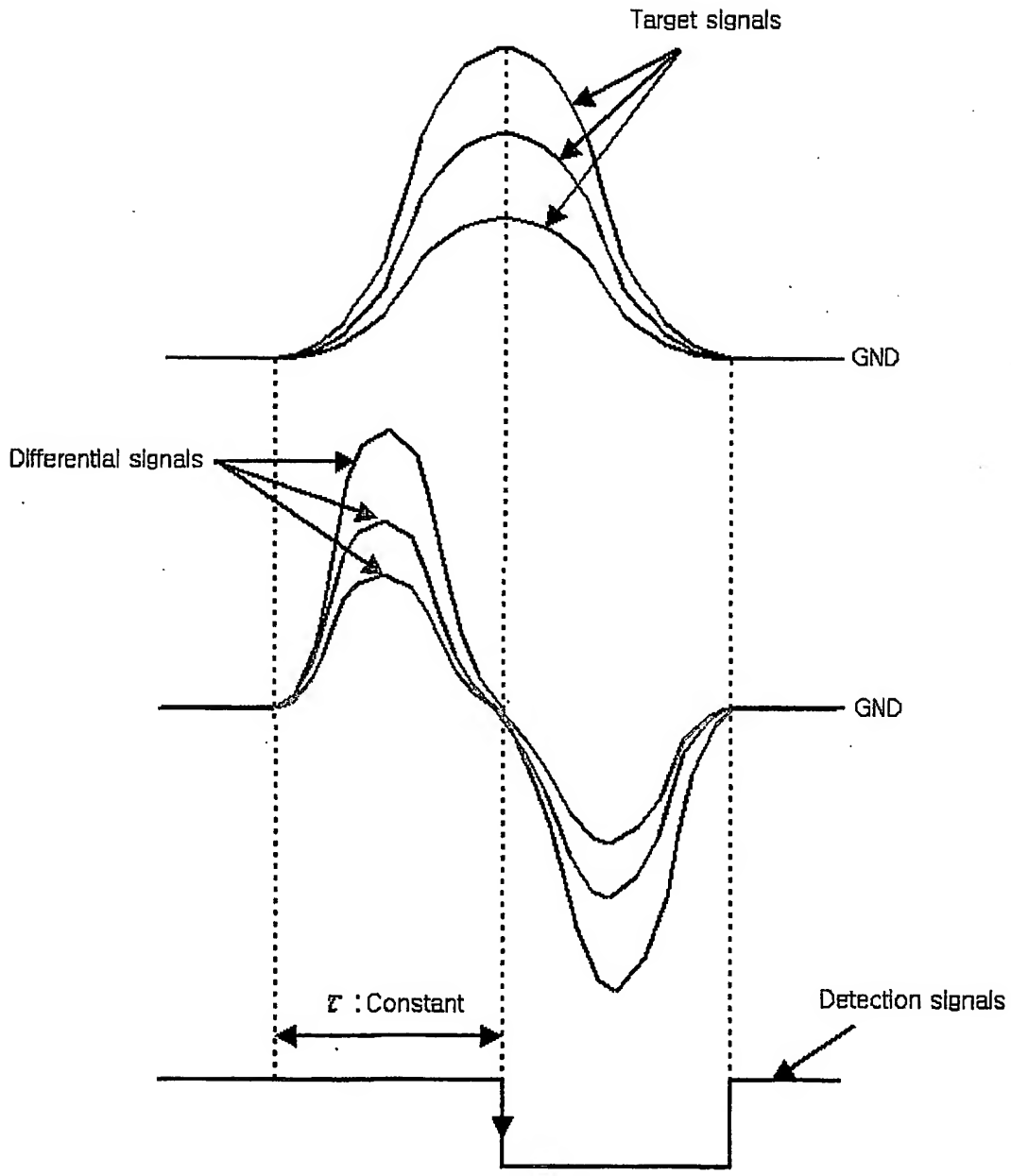

Target signals
Threshold voltage
GND
τ 1
Detection signals
τ2
τ3

FIG.8


Target signals
GND
Differential signals
GND
τ : Constant
Detection signals